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ORIGINAL RESEARCH

Pediatrics

Assessing proximity effect of high-acuity pediatric emergency departments on the pediatric readiness scores in neighboring general emergency departments

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Abstract

Study Objectives: The objective of this study was to determine if there is a proximity effect of high-acuity, pediatric-capable emergency departments (EDs) on the weighted pediatric readiness score of neighboring general EDs and whether this effect is attributable to specific components of the National Pediatric Readiness Guidelines.

Methods: Pediatric readiness was assessed using the weighted pediatric readiness score of EDs based on the 2013 National Pediatric Readiness Project assessment. High-acuity, pediatric-capable EDs were defined as those with a separate pediatric ED and inpatient pediatric services, including the following: pediatric ICU, pediatric ward, and neonatal ICU. Neighboring general EDs are within a 30-minute drive time of a high-acuity, pediatric-capable ED. Analysis was stratified by annual ED pediatric volume: low (<1800), medium (1800–4999), medium-high (5000–9999), and high (>10,000). We analyzed components of the readiness guidelines, including quality improvement/safety initiatives, pediatric emergency care coordinators, and availability of pediatric-specific equipment. Groups were compared using chi-squared or Wilcoxon rank-sum test with *P* values <0.05 considered significant.

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Results: Of the 4149 surveyed hospitals, 3933 general EDs (not high-acuity, pediatric-capable EDs) were identified, of which 1009 were located within a 30-minute drive to a high-acuity, pediatric-capable ED. Neighboring general EDs had a statistically significantly higher median weighted pediatric readiness score across pediatric volumes (weighted pediatric readiness score 76.3 vs 65.3; $P < 0.001$). Neighboring general EDs were more likely to have a pediatric emergency care coordinator, a notification policy for abnormal pediatric vital signs, and >90% of pediatric-specific equipment.

Conclusions: We found neighboring general EDs have a higher level of pediatric readiness as measured by the median weighted pediatric readiness score. High-acuity, pediatric-capable EDs may influence the pediatric readiness of neighboring general Eds, but further investigation is needed to clarify target areas for outreach by state and national partners to improve overall pediatric readiness.

KEYWORDS
Emergency department pediatric readiness, pediatric emergency care, pediatric readiness, pediatric emergency care coordinator

1 | INTRODUCTION

1.1 | Background

Children requiring emergent medical care have specific needs for optimal and timely treatment to ensure the best outcomes using evidence-informed treatment. In 2006, the Institute of Medicine showed that pediatric emergency care in the United States is variable because of the unequal distribution of emergency departments (EDs) that are fully prepared to care for ill and injured pediatric patients.[1] In 2003, an initial survey of US EDs demonstrated relatively low pediatric readiness as measured by a weighted pediatric readiness score that was based on published 2001 guidelines.[2,3] A collaborative group composed of the American Academy of Pediatrics, the American College of Emergency Physicians, and the Emergency Nurses Association joined the Emergency Medical Services for Children to improve pediatric readiness through targeted guidelines, quality improvement (QI) initiatives, toolkits, and resources.[4] The 2013 National Pediatric Readiness Project (NPRP) surveyed US EDs based on components of the 2009 published guidelines and assigned an overall weighted pediatric readiness score that reflected the availability of pediatric-specific equipment, staff, QI, and educational initiatives. There was an overall improvement in average pediatric readiness nationally between 2003 (weighted pediatric readiness score 55) and 2013 (weighted pediatric readiness score 69), but ongoing disparities in pediatric readiness scores were present.[5,6]

1.2 | Importance

Free-standing children's hospitals and/or comprehensive pediatric centers often serve as referral sites for critically ill and injured children. Prior literature has shown that caregivers in households with children are willing to travel up to 30 minutes to seek urgent or emergent care.[7] Within a geographic region, pediatric patients who live within 30 minutes of a highly pediatric-ready institution often have alternate EDs closer to their homes that have lower weighted pediatric readiness scores.[6] Caregivers and emergency medical services (EMS) systems may preferentially transport children to EDs based on proximity to the patient's home rather than the level of pediatric readiness.[8] Furthermore, it has been shown that ≈50% of children are transported to a facility with the highest pediatric readiness and an additional 22.3% living within 30 minutes of such a facility.[9]

Access to care and discrepancies in healthcare for children is difficult to fully address in a resource-limited system. The concept of regionalized care has been common in trauma systems as well as in stroke-ready and comprehensive cardiac center designation.[10] Creating systems of regionalized care is designed to improve standardized care for all patients, pediatric patients included. Multiple states have instituted pediatric medical recognition programs to promote and recognize an ED's capacity to provide high-quality pediatric emergency care.[11–13] Importantly, critically ill pediatric patients who present to EDs with a high weighted pediatric readiness score have decreased mortality.[14] The proximity effect of high-acuity pediatric EDs on neighboring general ED's pediatric readiness has not been previously described. Understanding the impact of proximity to a high-acuity, pediatric-capable ED could have implications for community outreach and emergency systems' planning, including how to optimize pediatric expertise and resources, and designing collaborative programs to improve a region's overall care of children. (Supporting Information)

1.3 | Goals of this investigation

We hypothesize that within a region, the presence of an ED in a hospital with the full spectrum of comprehensive pediatric capabilities

The Bottom Line

Hospital emergency departments that are located relatively close to hospitals with pediatric intensive care units (ICUs) and neonatal ICUs tend to have higher pediatric readiness scores. These highly capable facilities may improve the readiness of nearby hospitals, although unmeasured variables such as healthcare network affiliations could also contribute.

(pediatric ED, pediatric ward, neonatal ICU [NICU], and pediatric ICU [PICU]) is associated with differences in pediatric readiness scores across the neighboring versus non-neighboring general EDs in the region. Given the limitations in resource allocation, neighboring general EDs might commit less to pediatric readiness as transfer to definitive care is readily accessible. Alternatively, neighboring general EDs could have higher performance because of formal and informal collaboration and partnerships with local high-acuity, pediatric-capable EDs. As both outcomes are reasonable a priori, this work will serve as a hypothesis-generating study.

2 | METHODS

2.1 | Study design

We performed a retrospective cross-sectional observational study comparing neighboring general EDs to non-neighboring general EDs using geocoding from the 2013 NPRP assessment. This is a secondary analysis of the 2013 NPRP assessment data. Our primary outcomes were the median weighted pediatric readiness score overall as stratified by pediatric volume. Our secondary outcomes compared specific details of the overall weighted pediatric readiness score including pediatric QI efforts, presence of pediatric emergency care coordinators, safety measures, and pediatric-specific equipment (equipment that could not be replaced by modifying common adult equipment). The 2013 NPRP assessment surveyed 5017 hospital EDs in the territorial United States with a 55-question, web-based survey that resulted in an 83% response rate. The weighted pediatric readiness score was developed through an expert panel review, and a score of 100 indicated that the ED met all recommended guidelines for pediatric readiness.[5] Categories as described by the original study with point contributions included the following, for a total of 100: coordination of care, 19; MD/RN staffing, 10; QI, 7; safety, 14; policy/procedure, 17; and equipment and supplies, 33. Full details of the weighted scores can be found in the original survey.[5] We performed an additional analysis for hospitals that participated in an Emergency Department Approved for Pediatrics (EDAP) program after the first analysis. Sensitivity analysis of EDAP EDs was congruent with findings that did not abstract the EDAP hospitals and thus were analyzed in the overall group distributed between the neighboring general EDs and non-neighboring EDs.

2.2 | Definitions

We created a priori definitions using categories from the prior survey about the ED configuration and pediatric inpatient service available within the respondent hospitals. A children's hospital pediatric ED was defined as an ED that identified itself as one only caring for a pediatric population and that is part of a hospital only caring for children containing inpatient pediatric services, including a NICU, PICU, and inpatient pediatric ward. In addition, we defined a non-children's tertiary care ED as an ED with a separate pediatric ED in a general hospital where both adults and children are provided care, including dedicated inpatient pediatric services, including NICU, PICU, and pediatric wards. After a pilot analysis of the 2 categories showed no significant difference between these 2 groups, children's hospital pediatric ED and non-children's tertiary care ED were combined into a single category of high-acuity, pediatric-capable ED for further analysis. A general ED was an ED that did not meet the aforementioned definitions, even if the ED might have reported separate pediatric EDs and may have had some but not all pediatric inpatient services based on the pediatric readiness survey. A small number of EDs with incomplete demographics were excluded from the analysis (Figure 1). Of note, the weighted pediatric readiness score always refers to the pediatric readiness of the ED, not inpatient capabilities.

EDs were defined as "neighboring" if they were within a 30-minute drive time of a high-acuity, pediatric-capable ED using demographic data from the original survey. A 30-minute drive time, although arbitrary and binary, has been previously shown to be the length of time families are willing to drive for acute concerns.[7] In accordance with original confidentiality agreements from the initial survey, all geocoding was performed by National EMS for Children Data Analysis Resource Center investigators. The University of Utah's Department of Geography used ArcGIS (ESRI) to geotag hospitals within a 30-minute drive time (neighboring) or outside of a 30-minute drive time (non-neighboring) based on the original survey demographics. EDs were also categorized as urban, suburban, rural, remote, and undetermined using geocoding data.

Pediatric volume categories were defined as the number of pediatric ED visits per year as reported by NPRP participants as: low <1800; medium1800–4999; medium-high 5000–9999; and high >10,000.[5] When evaluating for differences in patient safety measures in neighboring versus non-neighboring EDs, the following quality and safety variables were selected from the full assessment: (1) presence of a QI process, (2) a policy qualifying that all children are weighed in kilograms, (3) a procedure for notifying the provider of abnormal vitals, and (4) a process for precalculated drug dosing. These 4 features represent straightforward targets that would be easy metrics for use in QI processes for representative hospitals. The list of pediatric-specific equipment was chosen from a subset of general equipment from the original survey as equipment specifically for neonatal and/or pediatric needs.

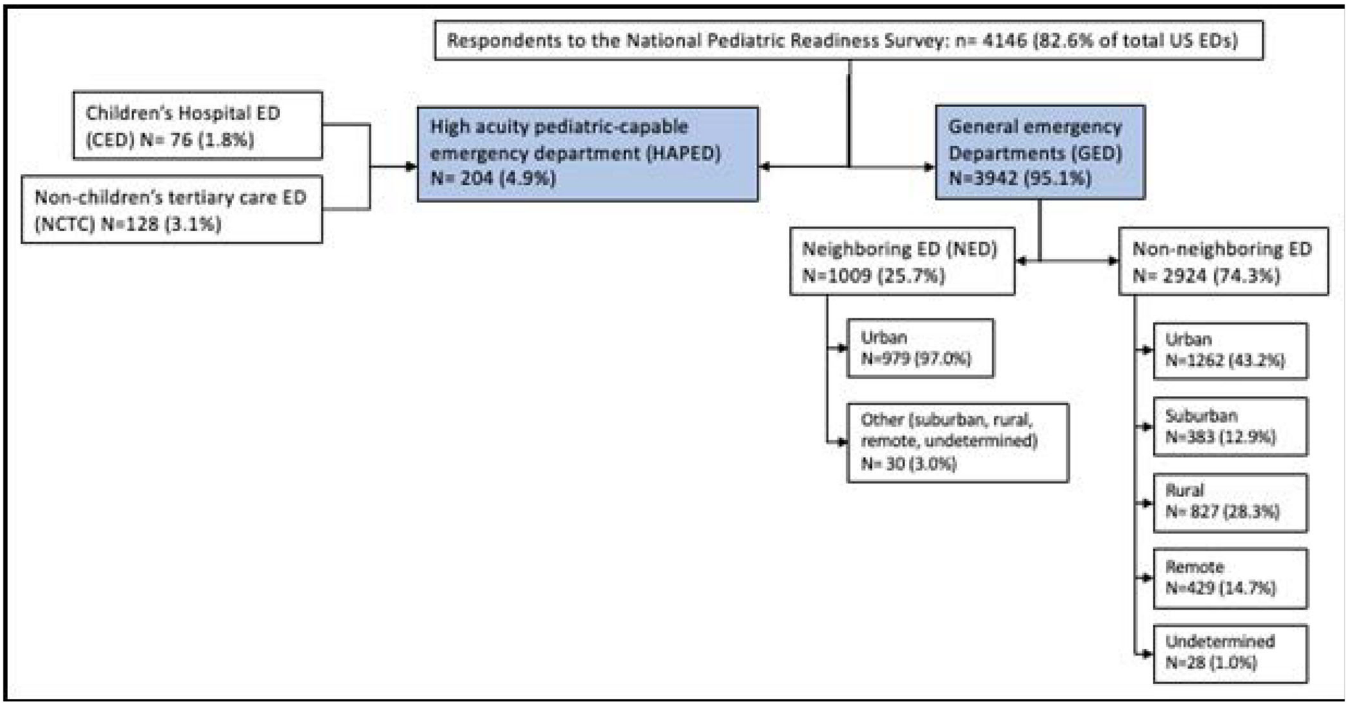

FIGURE 1 Emergency department (ED) demographics. Nine general EDs were excluded because of missing demographics. CED, children's ED (only cares for pediatric patients, pediatric ED, pediatric ICU [PICU], neonatal ICU [NICU], ward, and newborn nursery); NCTC, non-children's tertiary care hospital (hospital with separate pediatric ED in a general hospital caring for adults and children, NICU, PICU, pediatric ward, and newborn nursery); HAPED, high-acuity, pediatric-capable ED (combination of previously defined CED + NCTC)

2.3 | Analysis

The weighted pediatric readiness score was evaluated within pediatric volume categories in relation to proximity to a high-acuity, pediatric-capable ED using a Wilcoxon rank-sum test. The presence of pediatric emergency care coordinators, QI processes, specific safety measures, and pediatric-specific equipment was analyzed across the neighboring general EDs and non-neighboring EDs based on proximity to a high-acuity, pediatric-capable ED using a chi-squared test. A post hoc analysis was performed for EDs that participated in an EDAP program with the same methodology. Hypothesis tests were considered statistically significant when the 2-sided *P* value <0.05. All analyses were performed using SAS version 9.4 (Cary, NC).

3 | RESULTS

3.1 | Characteristics of the study hospitals

A total of 204 EDs (4.9% of the overall group) met high-acuity, pediatric-capable ED criteria. These high-acuity, pediatric-capable EDs were compared with 3933 total general EDs (Figure 1). Because of incomplete demographics, 9 hospitals were excluded from the general ED group (0.2%). Neighboring general EDs comprised 25.7% (n = 1009) of the total general EDs (n = 3942), the majority of which were in an urban setting (n = 979). Comparatively, there were 2924 non-neighboring EDs (74.3% total general ED), with a distribution across practice settings including urban (43.2%), suburban (12.9%), rural (28.3%), and remote (14.7%).

3.2 | Main results

The overall weighted pediatric readiness score was greater for neighboring general EDs (median weighted pediatric readiness score of 76.3 [interquartile range, IQR: 60.6, 88.6]) compared with non-neighboring general EDs (median weighted pediatric readiness score of 65.3 [IQR: 53.7, 78.1]; $P < 0.001$) (Table 1) across all volume categories.

A total of 333 general EDs participated in a pediatric medical recognition program, 148 of which were neighboring general EDs, 14.7% of the neighboring group. There were 185 EDAP EDs in the non-neighboring group, 6.3% of the non-neighboring general EDs. As expected, the overall median weighted pediatric readiness score for EDs participating in pediatric medical recognition programs was higher at 87.7 (IQR: 76.4, 93.2) compared with 66.6 for those who did not participate in such a program (IQR: 54.2, 79.1). Among pediatric recognized EDs, there was no difference in weighted pediatric readiness score regardless of proximity to a high-acuity, pediatric-capable ED. The median weighted pediatric readiness score was 88.2 (IQR: 78.6, 93.1) for neighboring EDAP EDs versus 86.8 (IQR: 74.6, 93.2) for non-neighboring EDAP EDs. However, in the general EDs that do not participate in a pediatric medical recognition program, neighboring general EDs had a higher median weighted pediatric readiness score at 73.7 (IQR: 59.3, 86.1) compared with non-neighboring hospital EDs

TABLE 1 Comparison of median weighted pediatric score by volume and proximity to high-acuity pediatric ED

Volume	Overall median (Q1, Q3), n = 3933	Neighboring ED median (Q1, Q3), n = 1009	Non-neighboring ED median (Q1, Q3), n = 2924	Median difference (95% CI)
Overall	67.6 (55.3, 81.2)	76.3 (60.6, 88.6)	65.3 (53.7, 78.1)	−11 (−12.9 to −9.1)
Low	61.4 (49.5, 73.6)	67.3 (51.7, 81.1)	60.8 (49.0, 72.2)	−6.5 (−10.6 to −2.3)
Medium	69.3 (57.9, 81.7)	75.2 (61.1, 85.7)	68.0 (56.7, 80.4)	−7.2 (−10.1 to −4.2)
Medium-high	74.7 (60.7, 87.5)	79.7 (65.6, 90.4)	72.5 (58.8, 84.8)	−7.1 (−11.1 to −3.2)
High	82.4 (65.6, 92.9)	85.9 (69.5, 92.9)	78.3 (63.4, 93.1)	−7.6 (−12.3 to −2.8)

Note: Wilcoxon rank-sum test (interquartile range [Q1, Q3]). Neighboring ED, <30 minutes from a high-acuity pediatric ED; non-neighboring ED, >30 minutes from a high-acuity pediatric ED. Volume definitions: low, <1800; medium, 1800–4999; medium-high, 5000–9999; high, >10,000.
Abbreviations: CI, confidence interval; ED, emergency department; Q1, quartile 1; Q3, quartile 3.

TABLE 2 Percentage of pediatric emergency care coordinators in neighboring versus non-neighboring EDs

Pediatric emergency care coordinator	Neighboring ED, n = 1009; % (n)	Non-neighboring ED, n = 2924; % (n)	Risk difference (95% CI), %
None	33.7 (340)	37.6 (1098)	−3.9 (−7.26 to −0.45)
Nurse only	13 (131)	20.3 (594)	−7.3 (−9.87 to −4.80)
Physician only	6.5 (66)	5.8 (169)	+0.7 (−0.98 to 2.51)
Both	46.8 (472)	36.4 (1063)	+10.4 (6.89 to 13.96)

Note: Chi-squared test. Neighboring ED, <30 minutes from high-acuity pediatric ED; non-neighboring ED, >30 minutes from high-acuity pediatric ED.
Abbreviations: CI, confidence interval; ED, emergency department.

weighted pediatric readiness score of 64.2 (IQR: 53.2, 76.4). These results are consistent with the results found without removing the EDAP EDs; therefore, for the rest of the analysis, EDAP EDs were analyzed within their respective proximity groups.

We then examined specific components of the assessment within neighboring general EDs versus non-neighboring general EDs. Overall, differences in the presence of pediatric emergency care coordinators between the neighboring and non-neighboring EDs were statistically significant with increased numbers of pediatric emergency care coordinators in the neighboring general EDs (Table 2). Of note, at low- and medium-volume EDs, a higher percentage of non-neighboring EDs had ≥1 pediatric emergency care coordinator, at medium-high and high-volume EDs, a higher percentage of neighboring general EDs had >1 pediatric emergency care coordinator (Table 3).

Overall, the median weighted pediatric readiness score of EDs that have ≥90% of pediatric-specific equipment is significantly different between the neighboring general EDs (weighted pediatric readiness score 83.4 [IQR: 70.7, 93.0]) and non-neighboring general EDs (weighted pediatric readiness score 73.6 [IQR: 62.3, 86.1]; $P < 0.001$). Of the neighboring general EDs, 9% had <75% of pediatric equipment compared with 15.6% of non-neighboring general EDs. High-volume general EDs had similar percentages of available pediatric equipment regardless of being neighboring versus non-neighboring (Table 4).

For medium, medium-high, and high-volume general EDs, the likelihood of having a pediatric QI process is statistically different between neighboring and non-neighboring general EDs. Regardless of proximity, engagement in QI processes in low-volume hospital general EDs is comparable at roughly 30% (neighboring, 31.0%; non-neighboring, 32.7%; $P = 0.599$) (Table 5).

3.3 | Limitations

Although this study was able to show a statistically significant difference in weighted pediatric readiness score related to proximity to high-acuity, pediatric-capable ED, no specific elements of pediatric readiness were found to be consistently different across pediatric volumes in the neighboring general EDs that could explain the higher weighted pediatric readiness score.

The study was limited by the NPRP assessment data and the 2013 study and might be outdated, and a more detailed evaluation of outliers in the general EDs was not possible because of adherence with the original confidentiality agreements and data set limitations. In compliance with confidentiality, it was not possible to explore formal affiliations that could be present in closer proximity EDs. If proximate hospitals represent the same health system, there might be shared clinical decision-making tools or QI processes in place but were unable to evaluate and therefore control for this in our analysis.

Given that this is a cross-sectional study, it is unknown how the weighted pediatric readiness score has changed over time, but with future NPRP surveys, additional data will be available for analysis. The binary value of a 30-minute drive time as the cut point between

TABLE 3 Percentage of pediatric emergency care coordinators in neighboring versus non-neighboring EDs by volume

	Neighboring ED, n = 1009; n or % (n)	Non-neighboring ED, n = 2924; n or % (n)	Risk difference (95% CI), %
No pediatric emergency care coordinator	340	1098	
Volume			
Low	35.9 (122)	48.2 (529)	−12.3 (−18.19 to −6.40)
Medium	32.1 (109)	31.7 (348)	+0.4 (−5.31 to 6.04)
Medium-high	20.0 (68)	15.7 (172)	+4.3 (−0.43 to 9.10)
High	12.1 (41)	4.5 (49)	+7.6 (3.93 to 11.27)
≥1 pediatric emergency care coordinator	669	1826	
Volume			
Low	20.8 (139)	45.7 (835)	−24.9 (−28.78 to −21.12)
Medium	30.3 (203)	31.8 (581)	−1.5 (−5.56 to 2.61)
Medium-high	28.3 (189)	14.7 (268)	+13.6 (9.80 to 17.35)
High	20.6 (138)	7.8 (142)	+12.8 (9.55 to 16.15)

Note: Chi-squared test. Neighboring ED, <30 minutes from high-acuity pediatric ED; non-neighboring ED, >30 minutes from high-acuity pediatric ED. Volume definitions: low, <1800; medium, 1800–4999; medium-high, 5000–9999; high, >10,000.
Abbreviations: CI, confidence interval; ED, emergency department.

neighboring versus non-neighboring EDs is arbitrarily assigned; in further analysis, distance could be treated as a continuous variable. In addition, given that 97% of the neighboring general EDs are in urban areas, it is difficult to determine the degree to which urbanicity impacts the weighted pediatric readiness score. Due to the vast majority being urban, we could not control for and individually compare between the various practice environments outside urban centers.

The initial analysis did not account for pediatric medical recognition programs, and although post hoc analysis showed that the overall results remained consistent with the larger analysis, and the overall percentage of EDs participating in such programs is small (14.7% of neighboring general EDs vs 6.32% of non-neighboring general EDs), this could have affected the average weighted pediatric readiness score of non–high-acuity, pediatric-capable EDs for the better based on the success of such programs as measured by readiness scores.

Finally, responses to the NPRP assessments are self-reported, and natural variation in the NPRP responders could bias the sample. Given the lack of demographics or further information from non-responders, it is difficult to make any conclusions.[13,15]

4 | DISCUSSION

Acutely ill and injured children will often initially present to a nearby ED rather than a pediatric-specialty ED, and EDs across the United States have highly variable pediatric readiness. Demands on emergency providers in general EDs are myriad: they are not only required to treat acutely ill and injured adults but also provide the same high level of care to pediatric patients with unique clinical needs. Depending on the nature of the practice environment, acutely ill and injured children might comprise only a small portion of the patient population. Although maintaining an appropriately sized endotracheal tube for intubating an infant is a straightforward solution, how to commit resources, support, and pediatric-specific training to maintain a high-functioning system of care to meet the needs of children remains an ongoing challenge in many general EDs.

Our study showed an association with higher weighted pediatric readiness scores regardless of annual pediatric volume in neighboring general EDs that are near high-acuity, pediatric-capable EDs. These findings remained consistent even after accounting for the population of EDs participating in a pediatric medical recognition program. Unsurprisingly, pediatric recognition program participants had higher median weighted pediatric readiness scores regardless of proximity (neighboring, 88.2; non-neighboring, 86.8), consistent with prior literature.[11–13] This study reiterates ongoing disparities for pediatric patients outside urban environments in access to high-quality care given the concentration of neighboring general EDs in urban centers. It is possible that regional outreach and education, QI methods, and transfer protocols contribute to improved weighted pediatric readiness scores in urban centers, but further research would be necessary to investigate clinical partnerships (both formal and informal) between high-acuity, pediatric-capable EDs and neighboring general EDs.

Determining the clinical relevance of the differences in weighted pediatric readiness scores across volumes in neighboring general EDs versus non-neighboring general EDs is more difficult. When compared with the IQRs that demonstrated mortality benefit, our neighboring general ED median IQR overlaps with the fourth quartile from prior literature, whereas the non-neighboring general ED does not. In addition, when treated as a continuous variable, mortality decreased as the overall weighted pediatric readiness score increased.[14] However,

TABLE 4 Percentage of pediatric-specific equipment in neighboring versus non-neighboring EDs by volume

	Neighboring ED, % (n)	Non-neighboring % (n)	Risk difference (95% CI), %
Low volume			
>90% of pediatric equipment	49 (128)	33.6 (458)	−15.4 (−22.0 to −8.9)
75%–90% of pediatric equipment	36.8 (96)	44.4 (606)	7.6 (1.2 to 14.1)
<75% of pediatric equipment	14.2 (37)	22.0 (300)	7.8 (3.0 to 12.6)
Medium volume			
>90% of pediatric equipment	53.8 (168)	46.9 (436)	−6.9 (−13.3 to −0.5)
75%–90% of pediatric equipment	35.9 (112)	42.0 (390)	6.1 (0.1 to 12.3)
<75% of pediatric equipment	10.3 (32)	11.1 (103)	0.8 (−3.1 to 4.3)
Medium-high volume			
>90% of pediatric equipment	63.0 (162)	54.5 (240)	−8.5 (−16.0 to −1.0)
75%–90% of pediatric equipment	31.5 (81)	36.1 (159)	4.6 (−2.6 to 11.9)
<75% of pediatric equipment	5.4 (14)	9.3 (41)	3.9 (0.0 to 7.8)
High volume			
>90% of pediatric equipment	72.1 (129)	67.5 (129)	−4.5 (−13.9 to 4.8)
75%–90% of pediatric equipment	23.5 (42)	25.7 (49)	2.2 (−6.6 to 11.0)
<75% of pediatric equipment	4.5 (8)	6.8 (13)	2.3 (−2.3 to 7.0)

Note: Chi-squared test. NED, <30 minutes from HAPED; non-NED, >30 minutes from HAPED. Volume definitions: low, <1800; medium, 1800–4999; medium-high, 5000–9999; high, >10,000.
Abbreviations: CI, confidence interval; ED, emergency department; HAPED, high-acuity pediatric ED; NED, neighboring emergency department.

TABLE 5 Percentage of neighboring versus non-neighboring EDs with quality and safety policies and procedures

Volume	Neighboring ED, n = 1009; % (n)	Non-neighboring ED, n = 2924; % (n)	Risk difference (95% CI), %
Low	31 (81)	32.7 (446)	1.7 (−4.5 to 7.8)
Medium	49.4 (154)	40.3 (374)	−9.1 (−15.5 to −2.7)
Medium-high	58.8 (151)	49.1 (216)	−9.7 (−17.3 to −2.0)
High	76 (136)	60.2 (115)	−15.8 (−25.1 to −6.4)

Note: Chi-squared test. Neighboring ED, <30 minutes from high-acuity pediatric ED; non-neighboring ED, >30 minutes from high-acuity pediatric ED. Volume definitions: low, <1800; medium, 1800–4999; medium-high, 5000–9999; high, >10,000.
Abbreviations: CI, confidence interval; ED, emergency department.

in trauma centers specifically, our overall weighted pediatric readiness score in neighboring general EDs did not meet the same fourth quartile range used, but both high-volume neighboring general EDs and non-neighboring general EDs did, which shows that pediatric volume is influential in the overall weighted pediatric readiness score.[16]

Our analysis showed a difference in weighted pediatric readiness score in general EDs related to proximity to high-acuity, pediatric-capable EDs, but questions remain regarding the role high-acuity, pediatric-capable EDs might serve in improving regional pediatric readiness. It is likely more attainable for providers in high-volume, high-acuity, pediatric-capable EDs, especially those with access to pediatric subspecialists, to help develop and implement decision support tools that could mirror the ST-segment–elevation myocardial infarction (STEMI) or stroke systems of practice.[10,17] Although STEMI and stroke centers have clear benchmarks to maintain designations, similarly clear performance measures for pediatric emergency care do not currently exist. Clinical decision pathways and patient safety policies could be shared across the region to help standardize pediatric emergency care. Targeted interventions in more distant EDs aimed to share resources and encourage evidence-assisted, pediatric-focused policies could be hugely beneficial in improving outcomes of critically ill or injured children.

Historically, the presence of a pediatric emergency care coordinator has a significant impact on the weighted pediatric readiness score of the ED. Having both a physician and nurse pediatric emergency care coordinator improved the median weighted pediatric readiness score to 82.2 across all pediatric volumes compared to EDs with no pediatric emergency care coordinator who had a median weighted pediatric readiness score of 66.5. When evaluated overall, the data suggest that there is a difference in the distribution of pediatric emergency care coordinators, with a higher percentage of neighboring general EDs reporting the presence of a pediatric emergency care coordinator. EMS systems have shown the benefit of having a shared pediatric emergency care coordinator between agencies in locations where the local resources cannot support a provider specifically designated for an individual agency, and this could be a model that more distant general EDs could explore as a potential part of transfer agreements with the high-acuity, pediatric-capable EDs.[18] Of note, it is encouraging that many low-volume, non-neighboring general EDs have designated a pediatric emergency care coordinator (45.7%), more than double the neighboring low-volume general EDs (20.8%), which demonstrates an important commitment to pediatric readiness in these sites that may be further removed from the urban concentration of pediatric resources.

It may be that a lack of frequent exposure to critically ill and injured children contributes to gaps in system-level readiness. Using the information from the NPRP assessment to provide important targets for QI is essential.[19] Neighboring general EDs were shown to have >90% of pediatric-specific equipment and, with the exception of low-volume hospitals, were likely to have pediatric-specific quality and safety policies and procedures. Both of these metrics have been shown to be associated with improved survival in pediatric trauma centers.[20]

Weight-based dosing and recognition of age-specific abnormal vitals are vital components of the assessment and treatment of ill and injured children, prevention of medical errors, and early identification of shock and are essential for all EDs to adopt. Prior studies have shown improvement in weighted pediatric readiness scores with simulation-based QI initiatives aimed toward specific features of care for critically ill children, including sepsis guidelines, cardiac arrest, seizure resuscitation, and overall team dynamics.[21,22] Critical access hospitals that represent many of the low-medium volume general EDs have identified some targets for improvement, some as straightforward as changing how children are weighed, but larger issues of building educational partnerships with transfer hospitals remain more difficult to implement.[23]

In summary, neighboring general EDs within a 30-minute drive time to a high-acuity, pediatric-capable ED are associated with increased weighted pediatric readiness scores compared with general EDs outside the 30-minute drive time. These results could indicate a targeted group of non-neighboring general EDs with which to concentrate pediatric readiness outreach efforts. In addition, ongoing efforts need to focus on increasing pediatric readiness in all EDs to provide effective, timely, and evidence-assisted emergency care to critically ill children.

AUTHOR CONTRIBUTIONS

Kristina Brumme, Hilary A. Hewes, Joelle Donofrio-Odmann conceived the study, designed specific aims, and proposed statistical analysis. Rachel Richards performed the statistical analysis. Marianne Gausche-Hill and Katherine Remick provided study design revision and commentary. Kristina Brumme drafted the manuscript, and all authors contributed substantially to its revision.

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CONFLICTS OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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